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FLOOD PREVENTION AND IRRIGATION: TWIN IDEAS.

BY UNITED STATES SENATOR J. R. BURTON, OF KANSAS.

FLOODS cause annually in this country an enormous loss of life and property. With the denudation of our forest area, the draining of our lands and the aggregation of wealth and population in the territory subject to overflow, the destruction increases.

The floods of the spring of 1903, by far the most disastrous in the history of the West, covered a territory of over 2,000,000 acres; they wiped out property approximating $40,000,000, and took nearly a hundred lives.

In 1901, in the Southern Appalachian region, flood losses reached $10,000,000; in a part of the same territory last spring the destruction amounted to perhaps $10,000,000 more, together with many lives. Frequent floods along the Ohio, the Arkansas, the Red River, and other rivers tributary to the Mississippi, not to mention local overflows in every part of the country, have spread disaster and death, while the June inundation of the lower Missouri and Mississippi, with its burden of devastation, is expected with the precision of the changing seasons.

Could the total loss of life and property resulting from these overflows each year be tabulated and published, startling facts would be presented to the American people—especially so when it is remembered that nothing has been done by the states or by the nation with the definite object of flood prevention.

We have done something toward keeping the flood waters of the lower Mississippi within bounds, but we have done nothing anywhere to prevent the gathering of those waters in one mighty, devastating, uncontrollable mass. Have we not begun our work at the wrong place? Instead of trying to control the flood waters of the lower Mississippi, why not prevent the floods? Let us, at least, see if we cannot impound these waters for the benefit and use of man, and at the same time take from them their destructive power.

Water in motion is unmanageable. Even in small quantities, while moving, it cuts its way through solid granite; in vast volume, it sweeps to destruction any barrier man has been able to place against it. Still water, on the contrary, is as obedient as a harnessed steed. High up along the tributaries of the streams that drain the continent, where the extended catchment areas collect the rainfall, is the place where the most effective measures may be taken to prevent flood-destruction (for there the excess of water can be conserved, and the flood itself averted); and not where the mighty torrents have swept their terrifying way far toward the sea. This does not mean that we should abandon our artificial embankments along the lower Mississippi; nor that we should cease constructing levees. It may be necessary to go on with that work, for a time, until we have adopted the better plan of getting control of the tributaries and headwaters, by means of dams, reservoirs and cut-offs, in the great catchment areas higher up.

James D. Schuyler, an eminent hydraulic engineer in the Government service, in an exhaustive report on the problem of water storage in Southern California, says:

> "There is a peculiar interest attached to the storage reservoir and distributing system which derives its supply from a torrential stream, as it is a creation of something of permanent value out of that which would not only be otherwise wasted and lost, but frequently would cause havoc and destruction of property in the act of going to waste. As its name implies, the torrential stream is one of violent force and action during certain intermittent periods of its career, and its power and capacity for destruction everywhere need to be curbed. Not the least useful of the functions of the impounding reservoir, therefore, is that of lessening the destructive force of the torrent upon which it is situated. Every possible encouragement needs to be afforded for such enterprises."

In a recent statement, Dr. J. F. Thompson, Honorary Secretary of the Royal Geographical Society of Australia, an irrigation engineer of international renown, who in making a tour of the world visited this country especially to study its irrigation systems, said he was astonished to find that no effort is being made in this country to control the floods of the Mississippi and

Missouri rivers, and make their surplus waters a blessing, instead of a means of spreading destruction and ruin. And he continued:

> "I see no reason why American engineers should not devise some means for conserving the surplus waters of the great rivers of their country. That the flood waters of rivers may be controlled by means of such reservoirs there can be no manner of doubt whatever; the only question of importance to be considered being one of ways and means."

The method advocated by Dr. Thompson has been employed with success by Australian and East-Indian engineers; and, quite recently, a report from Cairo indicates that all the benefits expected from the great dam at Assouan have been realized. This marvellous feat of engineering, under the direction of Mr. Webb, the director-general, has made a reservoir that gathers the waters during the winter for summer consumption, and has served the double purpose of preventing floods and vastly increasing the acreage of farm lands in lower Egypt.

Already, far-sighted men, who have had experience in irrigation in this country, begin to realize that water-rights and privileges depending upon reservoirs are far more secure than those depending upon the open ditch; and, hence, many of the older ditch companies are establishing systems of reservoirs, for the double purpose of securing the flood waters, and of making it more certain that the water can be had for use during the drought season.

Fiercely destructive are waters in flood volume; conserved for the benefits of power and irrigation they are tractable and life-giving. The physical conditions involved, though simple, merit careful study. Floods are due to the inadequacy of channels or rivers to carry the water. Channels are the results of the erosion caused by the ordinary flow of a stream, and floods are not frequent enough to enlarge the passage sufficiently for times of emergency. Before the destruction of the forests in the Mississippi Valley, and before the draining of the lands, floods came less often, and the stream was adequate to carry off the water that reached it in more equable proportion throughout the year.

In the Appalachian region, forests, designed by nature to serve as a great reservoir, have been felled in riotous prodigality, and floods sweep their way where of old they were less frequent and less violent. Prevention is feasible only through the preservation of the woodlands which remain and the restitution of those which have been made bare along the slopes and on the apex of that range of mountains.

The difference between what a river will hold and the excess is comparatively small. It is for the storing of this surplus that the reservoirs should be constructed; they would provide for the final few feet which are like the "last straw on the back of the riparian camel."

A practical illustration of the effect of canals and reservoirs in the prevention of floods, was furnished in the upper Arkansas during the very unusual and heavy rains last spring. The precipitation was practically as great in the catchment area of the upper Arkansas as it was in the catchment area of the Kaw; but the extensive canals and reservoirs in the Arkansas, from Pueblo down into Kansas, were sufficient to prevent any destructive flood along the valley of that river. It is also interesting to note that the reservoir system along that valley is in its incipiency, although the canals are sufficient to exhaust the normal flow. Had the upper Kaw Valley had the same number of canals and reservoirs as the upper Arkansas, it is safe to say there would have been little, if any, destruction in the Kaw Valley last spring.

But, suppose it were necessary to build five or ten times as many canals along the Kaw as are now constructed along the Arkansas, and with the canals a complete system of reservoirs, thousands in number, the total cost would be less than the loss of property by last spring's flood, to say nothing of the loss of life.

If it be contended that the levee system is the only way of controlling flood waters, then by all means push the levee system to completion, not alone in the lower Mississippi, but along the Ohio, the Red River, the Arkansas, the Kaw, the Platte, the Missouri, and all other rivers, and in turn their tributaries, and it will be found that the expense in the end will be as great or greater than the cost of impounding the waters in the arid and semi-arid, and even a portion of the rain-belt, districts. This leaves entirely out of the count the ability of the Government to recoup itself by the sale of the waters impounded; though we have already gone far enough, with our experience of irrigation, to realize that every particle of water that can be impounded will meet with a ready sale to the landowners below—and this statement can apply not alone to the arid and semi-arid districts, but to the rain-belt as well.

More than that: the building of levees on the lower reaches of great rivers does not in any way benefit the country above; whereas the construction of a reservoir system above would not only prosper the headwater area, but would prevent devastation by floods below.

Prevention of floods and irrigation are twin ideas. They should be developed together. The lower country should be protected from overflows, and the upper country should be given the water for irrigation and power. Our energies should be directed along this line.

The work should be done only after the most complete preparation. The entire catchment areas of the rivers should be explored fully, surveys made carefully, the topography of the country understood, the geological conditions examined. The channels should be studied and their carrying capacities gauged, the rainfall accurately measured, the amount of water at its flood fully determined, and the approximate expense of impounding the waters ascertained. Every local physical condition that science and industry can discover should be ascertained before entering upon this work; for if it be practicable to prevent floods and use flood waters for irrigation and power, there is hardly any expense, however great, that the undertaking would not justify.

There has been no complaint on the part of the West concerning the heavy expenditure made to control flood waters in the lower Mississippi. But the time has come when the country higher up should receive its protection as well as the country below. Especially does this claim have merit if, by the impounding of the waters, not only can the destruction below be lessened, but at the same time vast material benefits can be extended to the arid and semi-arid portions of the West.

It must be expected that many mistakes will be made in an effort to impound flood waters, and to stay the ravages caused by them. It is only a few years since the people of this country entered upon an intelligent use of water for irrigation, even in the arid district. And in accomplishing what we have along that line, many errors have been made, and great waste has occurred; but year by year a knowledge of irrigation and the beneficial and economical use of waters is being gained.

As new truths respecting irrigation were discovered, public sentiment was crystallized at last into law, in the irrigation bill passed by the last Congress. Already, work under that bill is being carried forward, for the purpose of impounding waters in artificial and natural reservoirs.

But all that has been done so far has sprung from a belief and confidence in irrigation, and not for the purpose of the concurrent prevention of floods. If by enlarging this work, beginning it at the foot-hills of the mountains and extending it on down through the plains, through the arid and semi-arid belts, and even farther down to the rain-belt, a vast system of reservoirs along the thousand and one smaller tributaries can be built, based upon these two ideas—prevention of floods and the beneficial use of the waters—the greatest and most practical material benefits may be realized.

The advantages of such an undertaking would not be confined to crop-raising and its attendant industries. Fuel is very scarce and expensive in almost all of the arid and semi-arid districts. There is but little coal, timber, oil or natural gas throughout that entire area. Since the development of electrical science, it has been found that water stored in reservoirs may be converted into power to an extent before unknown. From these reservoirs would come the cheap power so necessary to the development of any section.

Two methods are involved in the modern plan for the control of flood waters: first, the building of dams above the heads of navigation; and, second, the running of water into more or less natural and artificial reservoirs at either bank.

There is a popular delusion that the construction of a reservoir system for the prevention of floods means only the building of dams and the impounding of surplus waters behind artificial embankments. Nothing could be farther from the fact, though the utility of the dam is not a small part of the scheme, when the dam is built on rock foundation, extends from bluff to bluff, is provided with sufficient sluice-ways, and its maintenance is carefully looked after.

Despite the utmost precaution, waters held by artificial embankments ever involve an element of danger. Some of the greatest floods in the history of the nation have come from the breaking of these barriers when the "corroding tooth of time" has eaten away the support, as it is certain to do with all man's undertakings. Out on the open plains, far from quarries and with the loose soil for a base and little more than mud for building material, the life of a dam is short. Even in the great pastures of the cattle ranches, where draws are filled behind carefully constructed dams, the spring rains break away from the control and empty the basin upon which dependence has been placed for the summer's water supply. Hence becomes essential the depressed basin, which may be found naturally formed in many places, and may be constructed with little expense in others. With this it is different; the water remains and awaits the call for its use. It can neither be lost nor wasted. It is the stored-up moisture of the clouds kept ready for the need of man. Where nature has not provided the reservoir, it should generally be dug into the earth.

This storage of the surplus and its diversion from the streams to the lands, would tend not alone to prevent floods, but to extend the farm areas in the arid and semi-arid country, and vastly increase the power of the land to retain water. The sponge-area for the preservation of the rain-fall would be increased, lessening the sudden torrents that occur when the precipitation is great upon the unploughed prairies.

During the past ten years, the area of farm land increased by 217,982,000 acres, or thirty-five per cent., far more than in any other decade in the nation's history. Most of this increase occurred in the Western States. All the States and Territories west of the Mississippi, according to the figures given by the Director of the Census, increased their farm land area more than a million acres, excepting only Arizona and Nevada, which will come into the million-acre list by 1910, for there is a steady extension of agricultural operations in these sections. All through the semi-arid belt and on its edge, where the limit of moisture is closely pressed by the plough, the increase is most notable. The Dakotas, Minnesota, Nebraska, Kansas, Wyoming, Oklahoma, and Texas are the greatest gainers. In each of these sections is irrigation in practical operation; in each is there need of stored water; in each could farms be made more productive if the untimely rains were stored up for the time of need. The next decade will add to the demands on the Western rivers. The irrigation law itself proposes to add to the irrigated land over 15,000,000 acres in that time; and eventually 35,000,000 more acres will be artificially watered. There is no indication that the rain-fall is to increase. Will there be water enough to go around if we allow the surplus of the storm times to race away to the ocean, not only without use, but with positive danger to homes and improvements?

It may be objected that the East, which might not see that it would be benefited by the expenditure, would refuse to assist in the enormous undertaking of reservoir-building. The fact is that the East would be helped, not wronged. Its prosperity depends not on its own resources, but on the development of the vast grain-field that lies between the Mississippi and the Pacific coast. When, in the summer of 1901, there was a drought over the corn belt, and the farmers found themselves deprived of a large part of their usual crop of maize, it was not alone the West that suffered. Throughout the nation, in business and financial circles, spread the injury of that crop failure. Banks in Boston, as well as in Butte, were affected. The currency movements were deflected, and it took many months for the financial world to resume its normal course.

The anxiety over a wheat crop is nearly as keen in Wall Street as in Topeka. What a change if there could be kept in reserve so large a supply of stored water as to make the crops sure, and to bring to the market with unfailing regularity the rich fruits of the farmer's toil. There is water enough for use in this manner, if it can be held for use when needed, and not allowed to rush away to the sea.

It is true that the construction, by the Government, of such a comprehensive system of canals and reservoirs, and their maintenance, would add to the already large army of Government employees; and if they should be as active in our politics as are the postmasters, marshals, district attorneys and other Federal office-holders, they might represent a danger worthy of consideration. But it is safe to predict that the kind of employees required for this work would not become offensive in promoting machine politics. Almost anybody will do for a postmaster; but the construction and maintenance of canals and reservoirs, with proper regard for their great service, calls for men especially trained for the work. It would be with them, as it is with the present Government employees who are prosecuting scientific investigation; they would take no active part in partisan politics.

Again, it may be said that work of this kind is paternalistic in its nature, and that the Government should be overcareful of going into any enterprise that can by any possible means be performed by private capital. The answer to that objection is, that work of this scope can be done only by the national Government. In the first place, it covers too much territory, and will cost too much money, for its successful prosecution by private capital. The field is continental in its extent, and can be covered only by the general Government. In the next place, the interests are so varied, and the ramifications of their influence reach so far into the community life, as to make it necessarily a governmental task.

It seems that nature has invited us to this task. To those unfamiliar with the topography of the plains country, it is not known that, in the arid belt, and even as far east as the 96th meridian, all the way from the British possessions to the Rio Grande, nature has made indentations in the surface of the earth; and a careful survey will probably disclose that the reservoirs have been already largely provided and are merely waiting to receive the rain-fall from in-taking canals.

A scientific study of the country doubtless will confirm this statement, and beckon us on to this great work, just as the buffalo roving over the prairies, when first discovered, told in plain and emphatic language that on the prairies was the natural field for the development of the live-stock industry.

When such eminent engineers as Dr. Thompson, James D. Schuyler, and others of scarcely less note, pronounce so emphatically in favor of the impounding of waters to prevent floods, the attention of the country should be attracted to the subject; for if floods can be prevented they must be prevented. No such destruction and waste can longer be tolerated in this enlightened age, without some comprehensive effort to overcome it.

We spend millions of money each year to protect ourselves against fires. We do practically nothing to protect ourselves against floods.

If the plan suggested be not the best one, if the expense of conserving the waters be too great, then let another remedy be suggested. I claim no originality in suggesting this plan. As stated above, it has been advocated by irrigationists and hydraulic engineers in the past. It has been developed more or less successfully in other parts of the world. In nearly every case that I have been able to discover, it has been the outgrowth of irrigation; yet it is interesting to note that, about forty years ago, Dr. Christopher Graham, of Kentucky, published a plan he had thought out for disposing of the surplus water below St. Louis and Cairo. He did not believe levees furnished the solution for the overflow problem, and he took the ground that depressions could be found in the configuration of the earth into which the flood could be diverted from the rivers by canals. His purpose was the saving of life and property. He had no thought of irrigation. The enlightenment of later years has shown that he taught but a half-truth. The demand for arable lands has not only absorbed the lower river valleys, but has spread to the far tributaries that linger near the mountains; and millions of happy homes are to-day dependent on the bounty of artificially watered fields. The stored waters have now a double value—one of flood prevention, and one of wealth production.

On the western border of Kansas and in eastern Colorado the annual rain-fall is eighteen to nineteen inches. Thirty inches is enough to make a crop. The reservoir systems, carried from the headwaters to the lower levels of the streams, would supply the deficiency.

In the working out of the plan to a finality, it is probable that three great systems would have to be arranged: first, the reservoirs in the mountains and on the lower levels would hold back a portion of the floods; second, the vast net-work of main-line distributing canals, necessary to irrigate the ultimate acreage cultivated, scattered over the wide area, would have a great storage capacity; and third, the earth itself would act as a sponge, which would aid in holding back flood waters.

We are spending millions of money every year on rivers and harbors, millions more on the building of a navy to protect our commerce. We have spent in the last four or five years $500,000,000 in freeing Cuba and establishing our prestige in the Orient; and the better thought of the country sustains Congress in voting the stupendous appropriations for carrying out these enterprises.

We are a martial people, or—to put the proposition more bluntly and perhaps in less captivating form—we are a fighting people.

If our combative energies be directed along peaceful lines, in making possible new homes and in adding to the wealth and comfort of the dwellers therein, they are as nobly employed as when exerted on the march or the battle-field. Here is an opportunity to engage the best fighting qualities of our people. "Peace hath her victories no less renowned than War."

We have subjugated the Mississippi Valley, developed enormously our agricultural, manufacturing and mining resources; but we have reached a point where there is no frontier. The millions of acres of land now uncultivated, if they are to be utilized, must be irrigated. Other millions of acres in the lowlands, if they are to be safe from destruction must be protected from floods. Man can do nothing either to increase or to decrease the rain-fall; but the earth is his dominion, and, after the water strikes the earth, it is his to direct, harness and control.

If this solution be practicable, it promises greater good than any single form of development undertaken by us as a nation. That it is practicable is believed by the leading scientific engineers who have given the matter careful consideration.

To harness the rain-fall, thereby at once protecting the lowlands from desolating floods, utilizing the waters for the benefit of man and extending the farming area to meet the needs of an ever-growing population, forms a task worthy of the most earnest endeavor of our Government.

J. R. BURTON.